Recommendations of the DOE review committee, Feb. 2004
And Accelerator Division Responses

September 2004

Recommendation	Response/Action Plan
Accelerator Physics	
AP1: Expand integrated modeling across the accelerator complex (from linac to collisions) to include collective effects, impedance budgets, emittance preservation, and intensity limitations, such as space charge effects in the Booster. Pursue an aggressive emittance reduction campaign with these tools, supporting the urgent investigation of cold antiproton beam instabilities in the Recycler that might necessitate the use of a broad-band transverse damper. Report on progress at the next review.	A comprehensive operational model of the collider complex was developed late last year and is in use for setting operational strategy to maximize integrated luminosity to the experiments. Coherent efforts have been made to expand the modeling capabilities by creating a repository of optics and configuration data files for the entire accelerator complex. The repository is now ready and the design optics files for each machine will be eneterd within the next few weeks. Tests of beta version of the new optics software are expected to start soon. These two actions should help integrate optics of the entire complex. Actual machine optics files (verified by measurements) for all machines are expected to be in the repository by the spring of 2005. Presently, transverse emittances are below design values. The longitudinal emittances, however, are slightly larger than the design values and we have been vigorously pursuing their reduction. Commissioning 2.5 MHz pbar acceleration into operation is the cornerstone of this effort. Recent Recycler studies have shown that the observed transverse instability is driven by the resistive wall impedance and we need a transverse damper to suppress the instability. Specifications and damper design will be finalized by early September.

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AP2: Analyze baseline and luminosity scenarios, across multiple machines, under various fall back conditions, supported by a comprehensive model of the Collider complex. Report on progress at the next review.	This is in progress and the scenarios continue to evolve. Successful operation with mixed pbar shots in the Tevatron (pbars from both the Accumulator and the Recycler used for a single Tevatron store) has been an important positive development in the evolution of the luminosity scenario.
Proton Source	
PS1: Determine the zero-stack pbar stacking rate using slip-stacking including cogging necessary for multi-batch transfers and beam-loading compensation by May 2004.	A first such test was carried out with ~7.1E12 ppp on target, in July 2004. The measured zero-stack pbar stacking rate was 15 mA/hr instead of the previously attained maximum of 13.5 mA/hr without slip-stacking. The tests were performed with 6 RF stations in the Main Injector upgraded for beam-loading compensation (BLC). Subsequently, the tests were done several times with intensities in the range of 6.5-7.1E12 ppp on target. By the start of the '04 shutdown, 12 out of 18 RF stations had been upgraded for BLC.
PS2: Make short proton bunches for pbar production a priority.	The specification for slip stacking was to produce proton bunches of length 1.5 ns on target for pbar production. This has been met.
PS3: Develop an aggressive plan for machine studies to increase beam intensity and brightness in the Booster beyond its present state by May 2004. This plan should include making the gamma transition jump operational.	An aggressive plan is being pursued for increasing the Booster beam intensity. Major efforts so far include (1) commissioning of an integrated collimator/shielding system to manage beam loss which resulted in the ability to increase beam intensity, (2) lattice improvements and subsequent tuning and (3) understanding and improving the 400 MeV line optics and stability. The protons delivered by the Booster has gone up from 5E16 per hour in February to 8E16 per hour by August 2004. Work on the gamma transition jump continues. The hardware has

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	been installed and tested at high repetition rates. Data are being analyzed to determine quad misalignments and investigations are underway to determine if ramped correctors can be used to alleviate the problem.
PS4: Provide emittance measurements in the Booster throughout the cycle and include Linac and Booster beam characteristics into the performance overview of the Tevatron complex by May 1, 2004.	It is now possible to make emittance measurements throughout the Booster cycle using an Ion Profile Monitor. Also, there has been a significant increase in our understanding of the 400 MeV line and a much better measure of the emittance of the beam going into the Booster.
Antiproton Source	
AS1: Allocate pbar source study time in the order of six hours every second store to implement beam based alignment and obstacle finding procedures and reduce the discrepancy between expected and measured acceptances	We have averaged ~6 hours per week for pbar acceptance studies. Progress has been made in beam-based obstacle finding in the Debuncher. AP2 beamline plus Debuncher horizontal acceptance has been increased from 23π to 29π.
AS2: Continue instrumentation upgrades, in particular improvements to AP2 BPM to enable response matrix measurements with reverse protons in AP2.	Yes. This is continuing. The plan is to use a modified version of the Main Injector damper board to process and digitize the signals from the BPMs. The board will output the beam position and intensity measurements via ACNet. The prototype board fabrication is underway and is expected to be available for testing after the shutdown. The system upgrade is expected to be completed by early spring of 2005. In the meantime, we have instrumented the downstream vertical BPMs with oscilloscopes and have looked at the signals to understand and resolve the noise issue and to test pre-amplifiers on the BPMs for the upgrade.
AS3: Try slip-stacking as soon as possible, by May 2004.	Done. (See response to PS1)

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AS4: Continue efforts to better understand and suppress effects that currently limit stack-tail cooling performance. Impacts of further reduction of Debuncher momentum spread below the current design value of 6 MeV should be studied. Important fallback scenario if Recycler with electron cooling fails.	We have measured and characterized the current stacktail system and believe that it can handle ~28 mA/hour with no core cooling improvements. We have identified other limitations on flux into Accumulator (transverse scraping in Debuncher to Accumulator line) and are working on mitigating those problems. Debuncher momentum spread is currently below the target value of 6 MeV.
AS5: Perform urgently detailed design and performance requirements of transverse damper in the Recycler for resistive wall instabilities-this is required by spring 2005.	We are making good progress on the design. We are performing beam studies to finalize design specifications for bandwidth. (See response to AP1.)
AS6: The Committee recommends installation of further BPMs in the electron cooling return line in case of recirculation problems in the MI tunnel.	Done.
Tevatron	
T1: Provide sufficient time (at least two shifts per week on average) for beam studies and commissioning of new hardware.	Dedicated study periods in the Tevatron averaged about 16 hours per week (equivalent to 2 shifts per week) during FY04. These periods were used for both upgrade-related studies and maintenance studies. New hardware devices such as 1.7 GHz Schottky, tune tracker, and the head-tail instability monitor were successfully commissioned using this dedicated study time and additional parasitic study time. We will continue to allocate study time for commissioning new hardware consistent with the plan for maximizing luminosity delivered to the experiments.
T2: Commission the transverse injection dampers within the next three months.	Commissioning is in progress. This has not been high priority since it is not expected to impact luminosity unless further improvements to the damper design (in the works) are implemented.
T3: Reevaluate the resource loading of the Run II Upgrade Plan and develop appropriate tracking tools to easily assess the status	Being done. The resource-loading was re-evaluated in the development of v3 of the plan. While tracking continues with the

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of each subproject.	existing tools, improved methods for tracking costs are under development.
T4: Develop and carry-out a program of beam-based measurements and simulations to establish beam-separation requirements and helix design criteria for the design parameters in Run II. Present results at the next review.	Simulations as well as separator studies are in progress. Two extra separators will be installed in the '04 shutdown. These are would provide ~15% more separation in the long arc (between D0 and B0) during the collider store and help smooth the helix further.
T5: Pursue a vigorous investigation of beam-beam effects, including strong-strong beam-beam effects, to evaluate possible limitations on the ultimate Tevatron luminosity, and to evaluate possible amelioration. Present results at the next review.	The long-term program of simulation and studies for improving our understanding of beam-beam effects in the Tevatron continues, and this remains a focus of attention.
T6: Characterize the Tevatron aperture to quantify gains after alignment and optics improvements. Present results at the next review.	We have performed the required studies to characterize the Tevatron aperture before the '04 shutdown. The studies will be repeated post-commissioning after the shutdown to quantify the gains.
T7: Complete and document the alignment of the Tevatron.	In progress. We expect to make significant progress in documenting and correcting magnet rolls during the summer 04 shutdown.

Instrumentation	
I1: Investigate the source of kicker noise in the AP2 line BPMs during the March shutdown and improve the AP2 line BPM system to work with reverse protons over its entire length by the end of the summer 2004 shutdown.	Significant progress has been made in identifying sources of kicker noise in the AP2 line BPMs. Progress has been made in reducing the noise, as well. (Also, see response to AS2.)
I2: Perform a study of possible methods to measure the emittance evolution during the Booster ramp by May 1, 2004.	Significant efforts were made to understand the Booster optics and to calibrate the Ion Profile Monitor. It is now possible, therefore, to measure emittance evolution during the Booster ramp.
Cost Estimate	
CE1: Maintain the current level of rigor in developing and updating the cost estimate as the Project Office transitions to tracking and monitoring progress and performance against the cost benchmarks.	OK.
Schedule and Funding	
None	

Overall Management	
OM1: By June 1, 2004, produce a comprehensive plan addressing manpower needs and expected progress for the operations, commissioning, and maintenance components of Run II.	In order to develop a comprehensive plan, improved effort reporting was required to analyze the total Run II effort. This was developed and put into use in May. A model for the long-term operational support and maintenance will be developed by November.
OM2: By May 1, 2004, develop and implement procedures to utilize the Upgrade Plan as a basis to monitor and track and evaluate progress on the upgrades against expectations.	Done. Monthly status updates and progress in terms of % Complete, cost and effort reports are presented at the monthly PMG meeting and included in a written report to DOE.
Management Organization	
None	
Management Processes	
MP1: By April 1, 2004 develop and implement procedures to utilize the Upgrade Plan as a basis to monitor and track and evaluate progress on the upgrades against expectations.	Done. (See response to OM2.)

Planning and Plans	
PP1: The Upgrade Plan should continue to be internally reviewed and updated quarterly.	Being done.
PP2: The Upgrade program and progress should be reviewed a few months after the 2004 shutdown.	OK. Progress is reviewed monthly in the PMG meetings (see OM2). A thorough evaluation of the program and progress will be carried out in early 2005.
PP3: Necessary critical manpower should be explicitly identified as soon as possible.	This is done on an on-going basis. For example: (1) additional labor resources for electron cooling installation were identified and provided from Particle Physics and Technical Divisions, (2) additional need for work on TEL R&D was identified, a visiting engineer was recently added to the project and a post-doc candidate is being sought.
PP4: Consider publishing (website) more of the operational schedules, even though they might be quite dynamic.	Operational Schedules, control room and machine log books and other operational information can be accessed from http://www-bdnew.fnal.gov/operations/operations.html